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(54) A power stapler.

(57) A power stapler having an improved clincher provides a stitcher head (24) for driving formed staples (16) into a stack of sheets (12). A clincher box (70) is positioned opposite the stitcher head (24). Clinchers (46) located in the clincher box (70) pivot upwardly under the force of a moving clincher bar (74) to deform ends (62) of the staple (16) to pass through the sheet stack (12). The clincher bar (74) or clinchers (46) include a stop (72,76) that limits retraction of the clinchers (46) into the box (70). Hence, as the staple (16) is driven by the stitcher head (24) through the sheets (12), the ends (62) of the staple (16) are brought into engagement with the clinchers (46) and plastically deform into a substantially inwardly curled shape. Following driving of the staple (16) by the stitcher head (24), the clincher bar (74) is actuated to rotate the clinchers (46) upwardly toward the stack (12) causing the curled tips (68) of the staple (16) to drive into the sheets (12). The clinchers (46) can include grooves (52a) that are angled into alignment along parallel angled lines so that the ends (91) of the staple (89) pass each other and do not interfere with each other upon clinching.

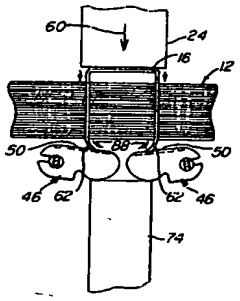

Fig. 5A

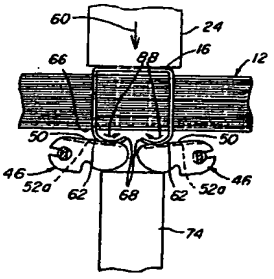

Fig. 5B

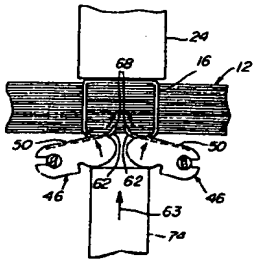

Fig. 5C

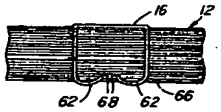

Fig. 5D

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Field of the Invention:

This invention relates to a power stapler and more particularly to an improved clinching head for use in a power stapler.

Background of the Invention:

Power staplers operated by pneumatic and/or electric actuators are widely used in document handling and document creation applications. Photocopiers and laser printers often incorporate a power stapler or "stitcher" in their mechanism to provide optional binding of completed documents.

Fig. 1 is an example of a typical implementation for a stitcher 10. A set of printed sheets 12 are fed either one at a time or as a group (as shown) to the stitcher 14.

The stitcher 14, itself, comprises an electromechanical and/or pneumatic stitcher shown schematically. A known stitcher such as the Hohner Universal 52/8 is contemplated. However, the principles of this invention are applicable to virtually any known stitcher mechanism. The stitcher 14 forms wire staples or "stitches" 16 as shown from a fed coil 18 of staple wire 20 in a conventional manner. The staple 16 is driven as shown by the arrows 22 by a reciprocating stitcher head 24 into a predetermined point on the stack of sheets 12 such as an upper corner as shown in Fig. 1.

Positioned opposite the stitcher head 24 is a clinching head 26 operated by pneumatic pressure in this example. The clincher head 26 bends the ends of the staple 16 inward upon themselves once the staple is forced completely through the stack. The resulting stapled stack is output to an output point 28 as shown in Fig. 1. As will be described further below, this invention has as an object the formation of improved staples by providing an improved clincher head. This invention also has as an object the stitching of variable thickness stacks of pages without requiring adjustment of the staple length.

Summary of the Invention

A power stapler according to this invention provides an improved clincher head for use in conjunction with a stitcher that drives staples through a stack of sheets. The clincher head includes clinchers that abut a stop that limits travel of the clinchers into the clincher head. Accordingly, as the staple is driven through the stack of sheets, its ends are brought into contact with the partially retracted clinchers. The angle at which the clinchers are positioned in their partially retracted, stopped, state is chosen so that the driven staple ends plastically deform inwardly toward themselves as they contact the grooved faces of the clinchers. The grooves within the faces of the clinchers are arranged at angles so that the guided ends of the staples moving therealong miss each other. This enables the use of a constant length staple in which ends would normally strike each other. The plastic deformation results in permanent inwardly disposed bends in each of the staple ends. When the final clinching step occurs and the clinchers are extended, the inwardly directed bends are driven into the face of the sheet stack. The finished staple, therefore, more closely resembles a conventional manually formed staple and is less likely to grab onto clothing and skin and more firmly binds the sheets together.

In a preferred embodiment in which a clincher bar is utilized to activate the clinchers, a stop can be mounted in the clincher head that interacts with a slot in the bar. The slot is sized and arranged to prevent retraction of the bar so that the clinchers rest on the bar in a partially retracted state and both the bar and the clinchers are prevented from full retraction into the head, thus forming the desired angle for forming inwardly directed bends in the staple ends.

Brief Description of the Drawings

The foregoing and other objects and advantages of the invention will become more clear with reference to the following detailed description of the preferred embodiments as illustrated by the drawings in which:

Fig. 1 is a schematic perspective view of a stitcher mechanism and the stapling process according to this invention;

Fig. 2 is a more detailed cross-sectional side view of a clincher head according to the prior art;

Figs. 3A-C are somewhat more detailed schematic side views of the clinching process according to the prior art;

Fig. 4 is a cross-sectional side view of a clincher head according to this invention;

Fig. 4A is a top view of the clincher head according to Fig. 4;

Fig. 4B is a perspective view of a staple formed in a thin stack of sheets using the clincher head according to Figs. 4 and 4A; and

Figs. 5A-D are somewhat schematic side views of the clinching process according to this invention.

Detailed Description

As discussed above, a stitching implementation according to Fig. 1 can be utilized according to this invention in order to bind sheets in a stack together using staples 16. The stitcher head 24 forms and drives staples 16 through the stack and the clinching head 26 subsequently, by means of a pneumatic actuator 30, bends the ends of the staple 16 passing through the stack 12 to bind the staple 16 to the stack 12. While the stitcher 14 in this example is located above the clincher head 26 in this implementation, it can be

preferred in some embodiments to locate the clincher head 26 above the stack 12. As used herein "above" and "below" will refer to orientation of components relative to the clincher head surface 54 and not to the orientation of components relative to the ground.

Fig. 2 and Figs. 3A-C further detail a prior art clincher head. The head 26 comprises a block 32 that can include two core pieces 34 along the sides of the head 26 and outer plates 36 bolted to the core pieces to form a hollow interior channel 38. The lower portion of the channel 38 is substantially rectangular and allows a clincher bar 40 constructed, generally, of hardened steel to slide therein. The bar 40 can move along the channel 38 as shown by the double arrow 41. The bar 40 is connected to a pneumatic actuator 30 that advances and retracts the bar 40 upon application of pressure. The stitcher according to this invention includes timing circuitry (not shown) that controls the timing of staple formation, staple driving and clinching respectively. Clinching, in general, is the final step in the process. A valve 42 on the actuator air line 44 that is connected to the timing control circuitry governs the application of air pressure to the actuator 30.

The bar 40 acts to move a pair of clinchers 46 located at the uppermost end of the clincher head 32. The clinchers 46 are seated between the outer plates 36 on pivots 48. The clinchers 46 have flattened upper surfaces 50 that, according to this embodiment, include grooves 52 for guiding a staple wire therealong. The clinchers 46 rotate on the pivots 48 between a fully retracted position in which the clincher upper surfaces 50 define an angle A with the flat upper surface 54 of the clincher head 32, and a fully extended position in which the upper surfaces 50 pass out of the clincher head (as shown in phantom). The clinchers 46 according to this embodiment can be pivoted upwardly out of the head surface for removal by aligning the rear slots 56 of the clinchers 46 with the thinner cross section of their rectangular pivot 48. However, removability of the clinchers 46 is not necessary according to this invention.

In a fully retracted state (shown by solid lines), the bar 40 is substantially out of contact with the clinchers 46 so as to allow them to retract fully into the clincher head 32, hence defining the angle A. The bar 40 can be extended upon actuation as shown by the extended bar (in phantom) to force the clinchers 46 beyond the upper surface 54 of the head 32. Practically, the opposing stitcher head 24, as shown in Fig. 1, limits the outward extension of the clinchers 46. This is further illustrated in Figs. 3A-C which will now be described.

In Fig. 3A, the staple 16 is driven (arrow 60) through the sheet stack 12 by the stitcher head 24 until the staple ends 62 pass out of the opposing side of the stack and into contact with the upper surfaces 50 of the clinchers 46. Since the clinchers 46 are retracted and the clincher bar 40 is not extended into contact with the clinchers 46, the staple ends 62 remain relatively straight at this time.

Fig. 3B illustrates the step following driving of the staple 16 by the stitcher head 24. The bar 40 is then extended upwardly (arrow 63) so as to rotate the clinchers 46 toward the staple ends as shown by the arrows 64. Accordingly, the staple ends 62 rotate about the bottom face 66 of the stack 12 until the ends are brought into parallel alignment with the bottom face 66 of the stack 12.

At this time, the stack 12 has been firmly bound by the staple 16 as shown in Fig. 3C and is ready for output from the stitcher mechanism.

The extreme retraction of the clinchers 46 as shown in Figs. 2 and 3A-C causes the ends 62 of the staple to bend into virtually parallel alignment with the stack bottom face 66 (see Fig. 3C). The bent ends 62 of the staple 16 are, thus, somewhat unlike those formed by the manual staplers in which the tips 68 of the bent ends 62 are driven back into the lower face of the stack and often dig into the face. As a practical matter, the parallel ends 62 generated by a power stitcher can catch on clothing, often include burrs that abrade skin causing cuts and are more prone to become unbent and allow the stack to unbind.

Fig. 4 illustrates an improvement to the clincher head 26 of Fig. 2 in which a clincher head 70 is provided that limits retraction of the clinchers 46. Hence, the angle Al defined between the upper surfaces 50 of the retracted clinchers 46 and the surface 54 of the clincher head 70 is reduced from the angle A of Fig. 2. Such a reduction is facilitated according to this embodiment by forming a channel 72 in the clincher bar 74 and inserting through-passing bolt or stake 76 in which the channel 72 rides. The stake 76 is held by the outer head plates 78 which include holes for retaining the stake 76. The length channel 72 is chosen so that the lower end 80 of the channel 72 still allows maximum extension of the bar 74 (as shown in phantom), but the upper end 82 of the channel 72 limits retraction of the bar 74. Retraction of the bar 74 is limited so that the clinchers 46 remain in contact with the upper end 84 of the bar 74 and define therewith an angle Al.

While the bar 74 in this embodiment is used to limit retraction of the clinchers 46 so as to define the angle Al, other methods of limiting clincher 46 retraction are expressly contemplated according to this invention. For example, each clincher 46 can have associated therewith its own stake or bolt that limits retraction. The clinchers can also be formed so that lower ends 86 thereof contact the central blocks 34 of the clincher 46 upon a certain predetermined degree of retraction. The blocks 34 would have to be lengthened or the lower ends 86 of the clinchers 46 would have to be extended to limit retraction to the appropriate angle Al. These alternatives are not shown but are expressly contemplated.

The angle Al is chosen, according to this embodiment, based upon usually trial and error so that an optimum shape for the staple end 62 is generated. The angle Al causes formation of staples with ends 62 as illustrated in Figs. 5A-D which will be described further below.

As stack thicknesses vary, it is normally desirable to vary the length of the staple. In this manner, the ends of the staple are spaced from each other when the staple is clinched as shown by the space 75 in Fig. 3C. Otherwise, the ends of the staple, which are normally collinear (i.e. both along the same line which in this example is perpendicular to the axes of the clincher pivots 48), tend to strike each other causing a defective stitch.

The clinchers 46 according to this embodiment include grooves 52a that are angled relative to each other as illustrated in Fig. 4A. Each groove 52a is offset by an acute angle B to grooves define noncollinear lines that are parallel to each other. Thus, staple ends riding within the grooves 52a tend to pass each other even if they are long enough to meet.

Fig. 4B illustrates a stack 87 that would be considered too thin for the length of staple 89 chosen. Accordingly, in a conventional clincher embodiment in which grooves are aligned along a single common line (i.e. "collinear"), the staple ends 91 would collide. Conversely, however, by utilizing angled grooves 52a according to this embodiment, the ends 91, upon clinching, pass by each other and do not interfere with each other.

Referring now to the operation of the stitcher according to this embodiment, Fig. 5A illustrates the driving of a staple 16 through a stack of sheets 12. The stitcher head 24 is still in the process of driving (arrow 60) the staple when the ends 62 contact the retracted clinchers 46 that are shown resting on the clincher bar 74 in a less retracted state than in Figs. 3A-C. As such, the staple ends 62 begin to bend toward each other (arrows 88) along the slightly downwardly angled slopes of the clincher upper surfaces 50.

As the staple 16 is fully driven into the stack as shown in Fig. 5B, the tips 68 of the staple end 62 have bent inwardly slightly toward the lower stack face 66. The clinchers 46 have not yet moved upwardly under the force of the bar 74, but are at this time only resting on the bar 74. The reason the tips 68 bend in slightly is that, unlike the example of Fig. 2, the angle Al of the less retracted clinchers 46 of this embodiment are chosen so that the bending of the staple end tips 68 imparts a force on the ends 62 that is greater than the elastic limit of the staple wire. The fully retracted clinchers 46 of Fig. 2 can cause slight bending of the ends 62, but this bending does not impart a force that exceeds the elastic limit of the staple wire. Hence, only the final clinching step (Fig. 3B) results in plastic deformation of the staple wire. This final clinching step (Fig. 3B) thus, causes a full 90° bend in the staple 16 proximate its exit point from the lower stack face 66. Conversely, plastic deformation of the staple ends 62 according to this example begins before any movement of the clinchers 46 in the clinching step. The angle Al insures that the bending of the ends 62 orients the tips 68 of the staple back inwardly toward the lower stack face 66.

When the clinching 46 step occurs as shown in Fig. 5C, the inwardly bent tips 68 are forced back into the lower stack face 66. The tips, thus, form a more traditional curled-in staple end 62 as shown in Fig. 5D. The inwardly directed tips 68 are not as prone to grab on clothing or skin and serve to more firmly bind the stack of sheets together.

While the clinchers 46 according to this embodiment are angled to form as large a curve in the staple end 62 as possible, certain types of staple wire may be more resistant to plastic deformation than others. Thus, the angle Al should be at least sufficient to cause the ends 62 of the staples to plasticly deform slightly. The inward curl of the staple 16 need not be pronounced to attain a desired result. Even a slight inwardly projected bend in the staple end 62 will prevent grabbing and enhance grip of the staple 16 on the sheet back 12. The staple 16 can still carry a shape substantially similar to that of more conventional power stitchers except that the tips are now directed toward the stack face and are generally aligned along parallel angled lines.

The foregoing has been a detailed description of a preferred embodiment. Various modifications and equivalents can be made without departing from the spirit and scope of this invention. This description is, therefore, meant to be taken only by way of example and not to otherwise limit the scope of the invention.

Claims

1. A clincher assembly for a power stapler comprising:

   a clincher head defining a plane for engaging a face of a stack of sheets positioned above the plane;

   a pair of clinchers having surfaces for engaging ends of a staple, the clinchers being pivotally mounted in the clincher head so as to pass below and substantially into the plane; and

   a stop structure for limiting pivoting of the clinchers below the plane to no more than an angle Al that causes at least part of the ends of the staple to plastically deform as the ends are driven through the stack of sheets into contact with the clinchers.

2. A clincher assembly as set forth in claim 1 further comprising a clincher bar positioned below the

clinchers for forcibly pivoting the clinchers upwardly toward the plane.

3. A clincher assembly as set forth in claim 2 wherein the stop is positioned to limit downward travel of the clincher bar.

4. A clincher assembly as set forth in claim 3 further comprising a power stapler for forming and driving staples through the stack of sheets into the clinchers.

5. A clincher assembly as set forth in claim 4 further comprising a pneumatic actuator for driving the clincher bar.

6. A clincher assembly as set forth in claim 5 further comprising a controller for operating the stapler to drive a staple at a first time and for operating the actuator at a second subsequent time to pivot the clinchers upwardly.

7. A clincher assembly as set forth in claim 1 wherein each of the clinchers includes grooves for guiding the ends of the staples therealong.

8. A clincher assembly as set forth in claim 7 wherein each of the grooves is aligned along a different line, and each different line is noncollinear and positioned at an acute angle relative to a line perpendicular to a pivot axis of each of the clinchers so that the ends of the staple are noncollinear with each other.

9. A clincher assembly as set forth in claim 8 wherein the different lines are parallel to each other.

10. A method for forming staples using a power stapler comprising the steps of:

providing sheets at a stitcher head;

operating the stitcher head to drive staples through the sheets, the staples having ends that pass through the sheets;

providing clinching surfaces opposite the stitcher head, the surfaces rotating pivotally toward the sheets and stitcher head and the surfaces being angled so that the ends of the staple become plastically deformed toward each other as the staple is driven into engagement with the clinching surfaces; and

rotating the clinching surfaces forcibly upward to bend the ends to deform the ends into an orientation against the sheets.

11. A method as set forth in claim 10 wherein the step of providing clinching surfaces includes providing grooves for guiding the ends of the staple, the grooves guiding the ends along noncollinear lines so that the ends are maintained out of contact with each other.

12. A method as set forth in claim 11 wherein the noncollinear lines are parallel to each other and at acute angles to a line perpendicular to a pivot axis of each of the clinching surfaces.

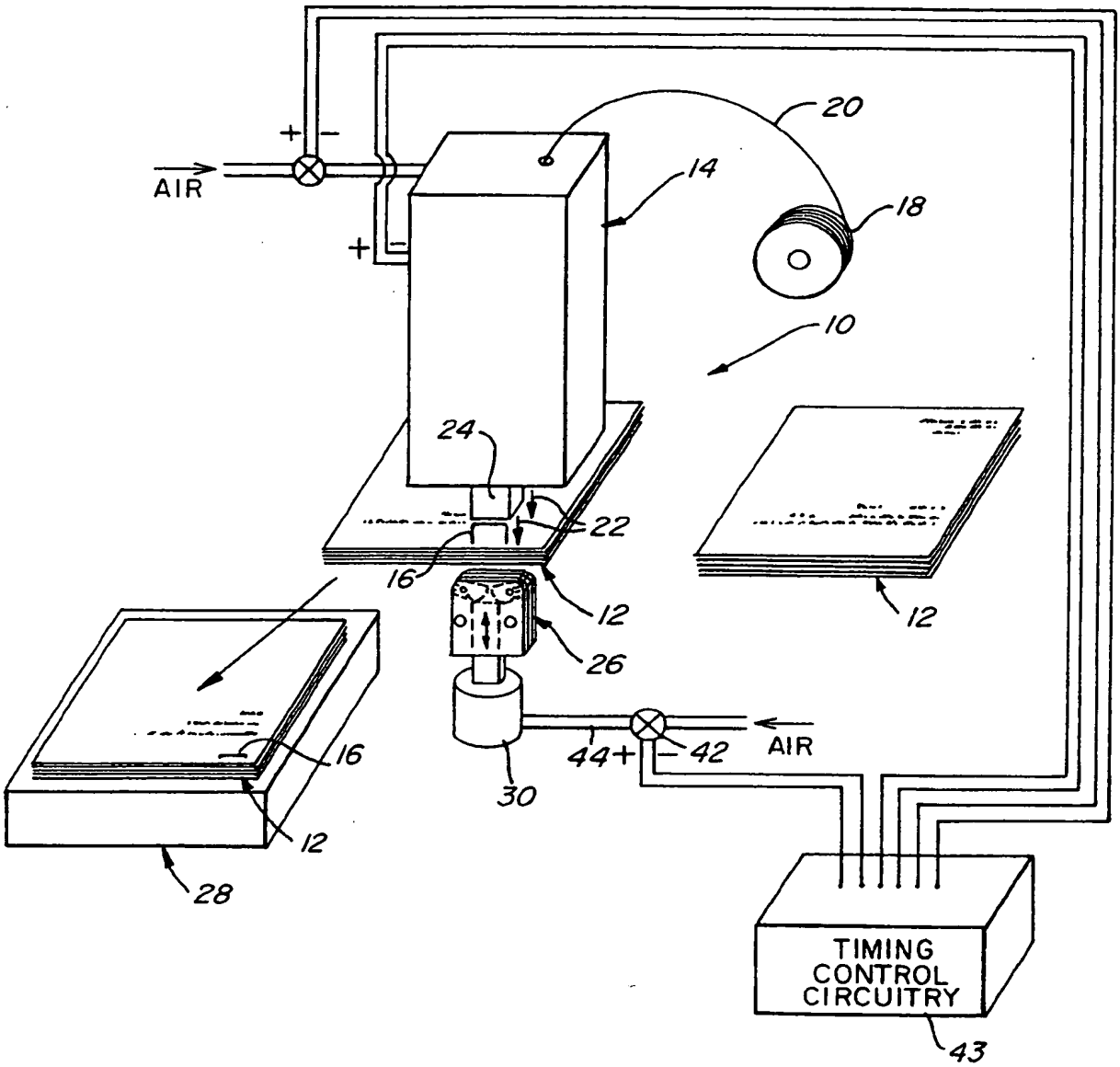

Fig. 1

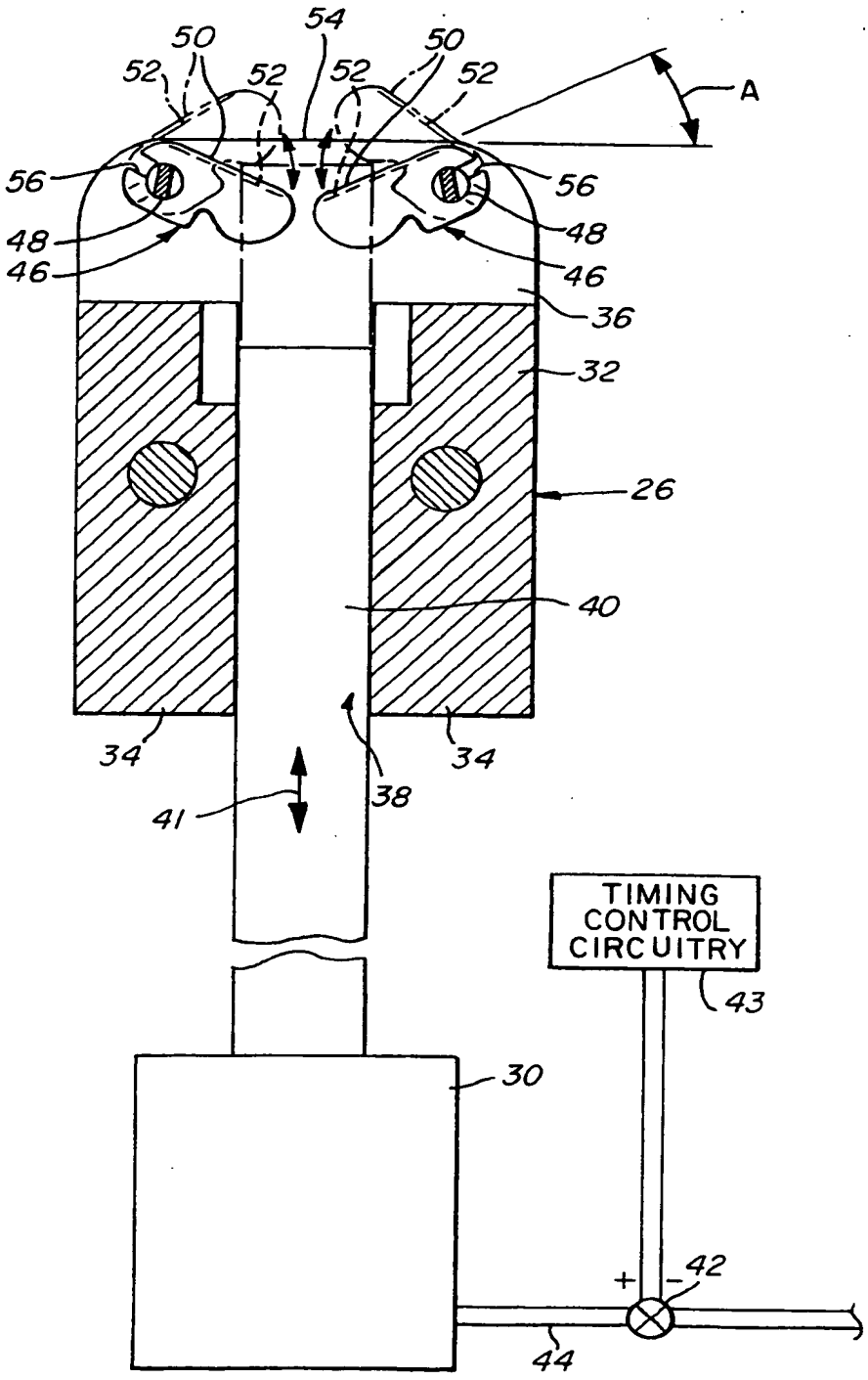

Fig. 2
(PRIOR ART)

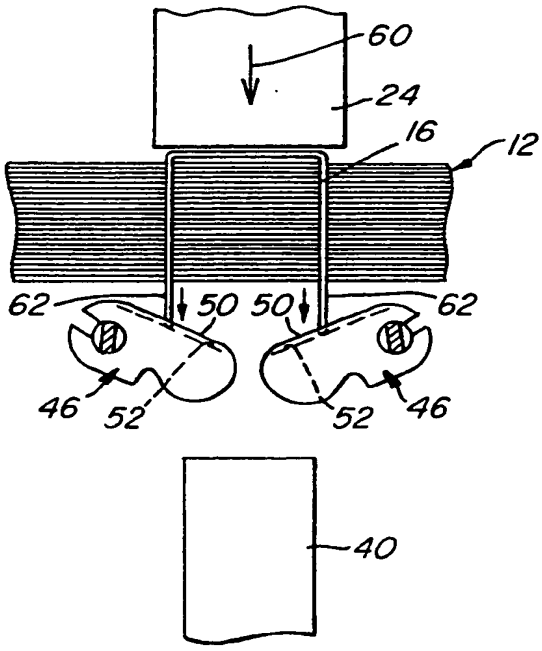

Fig. 3A
(PRIOR ART)

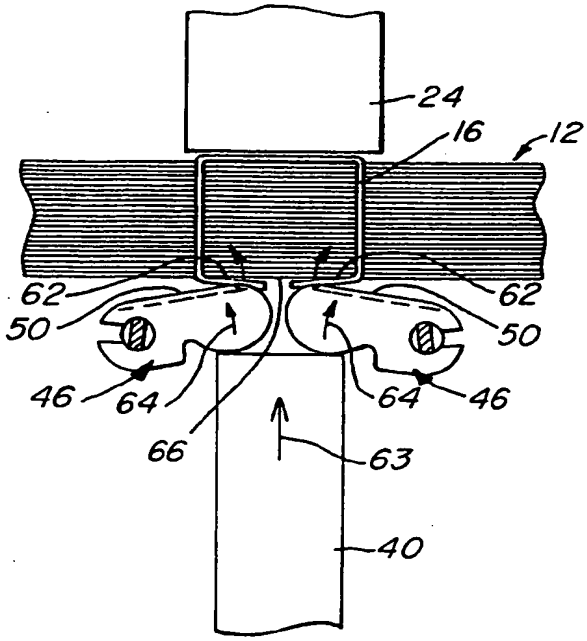

Fig. 3B
(PRIOR ART)

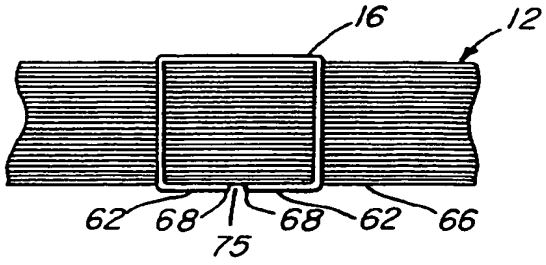

Fig. 3C
(PRIOR ART)

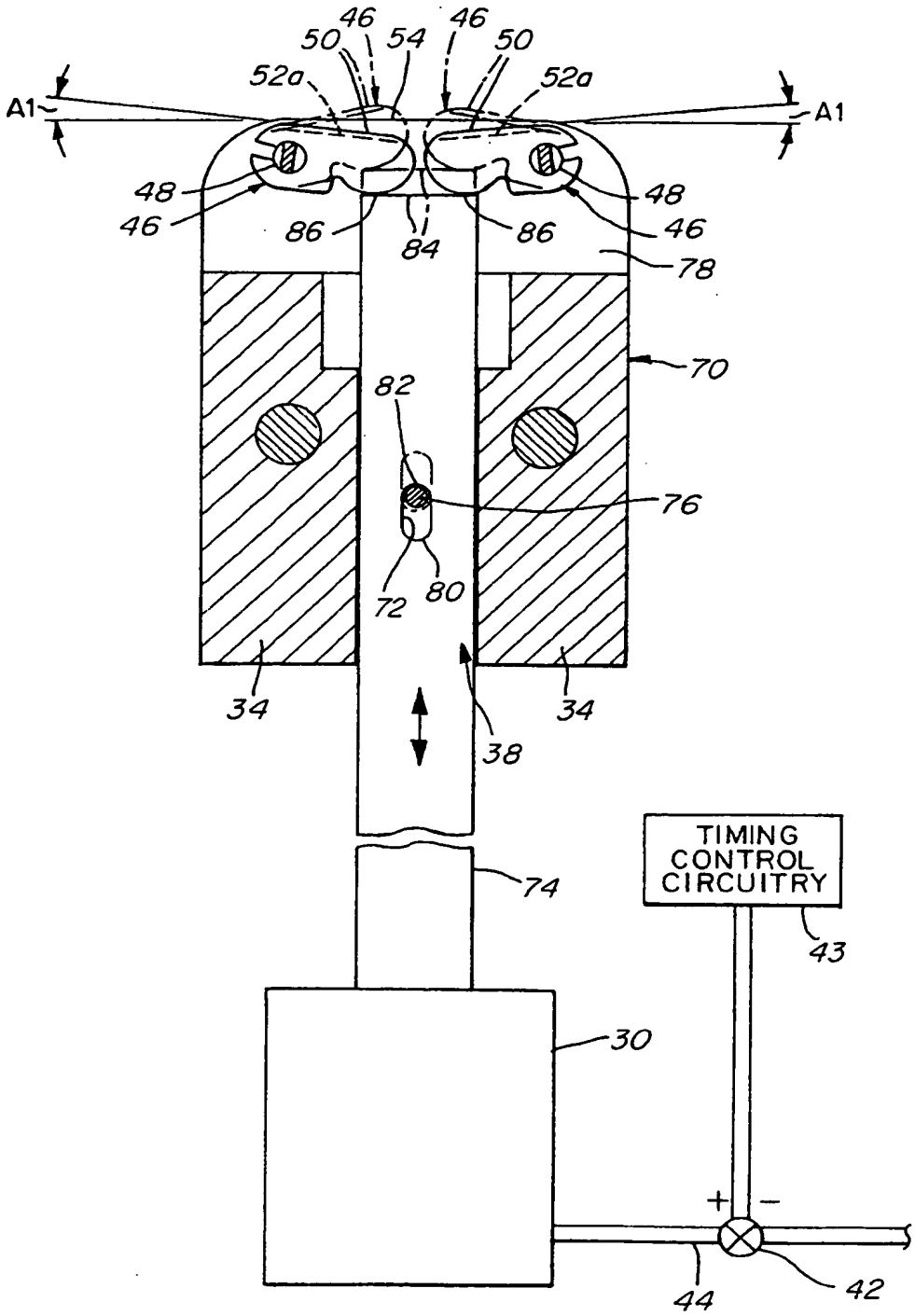

Fig. 4

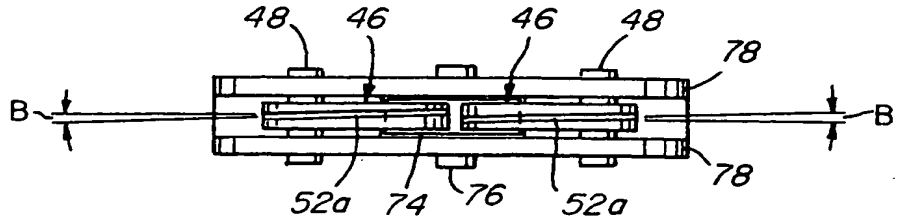

Fig. 4A

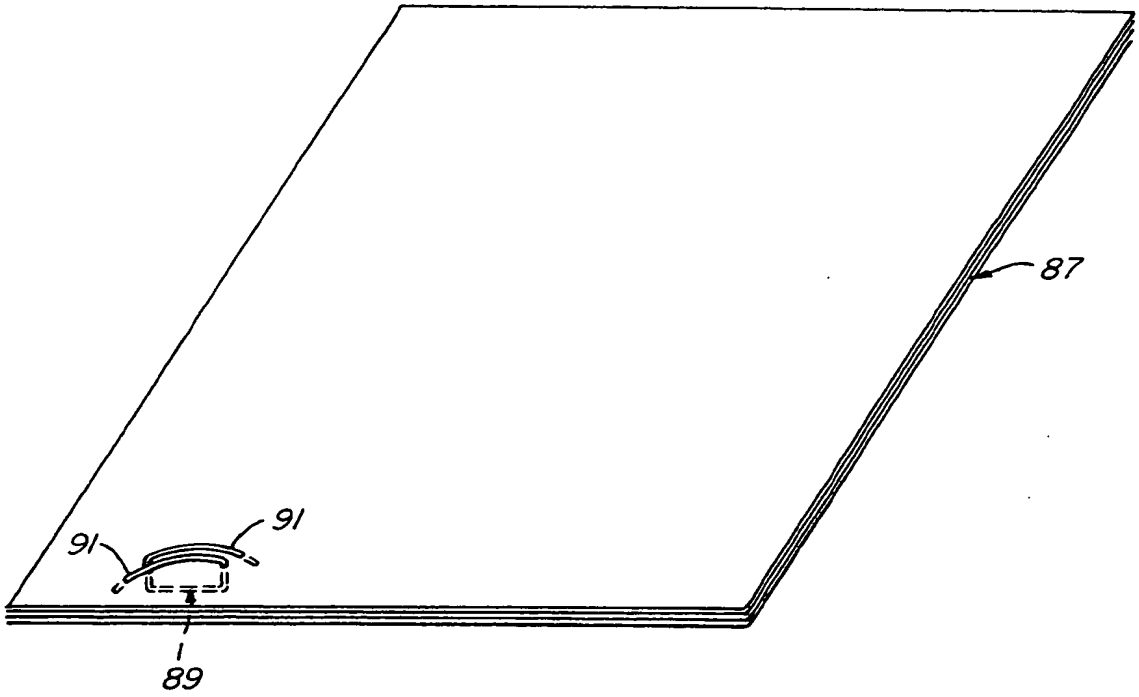

Fig. 4B

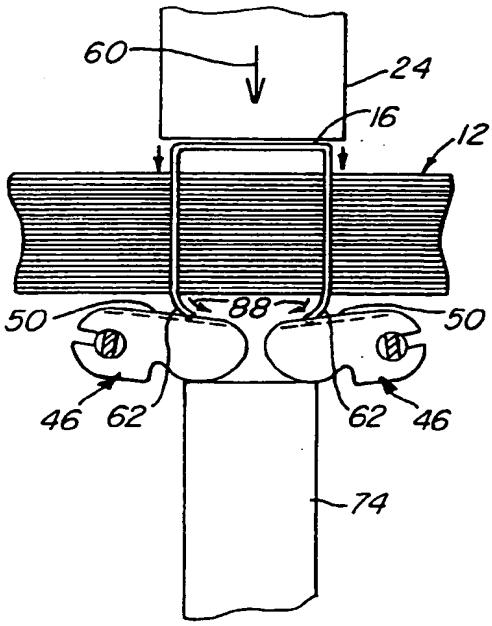

Fig. 5A

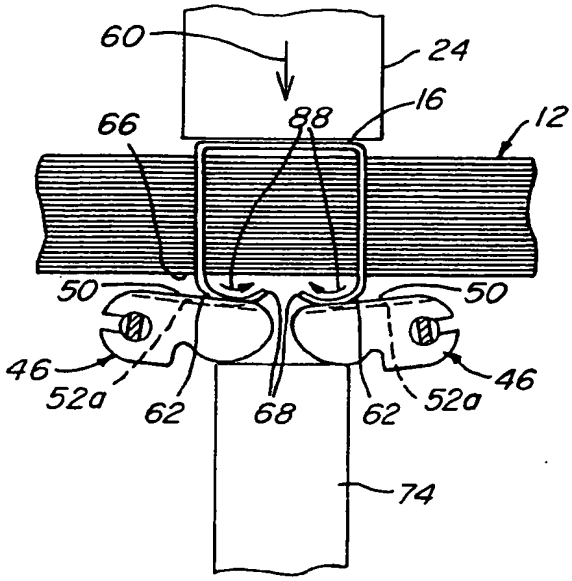

Fig. 5B

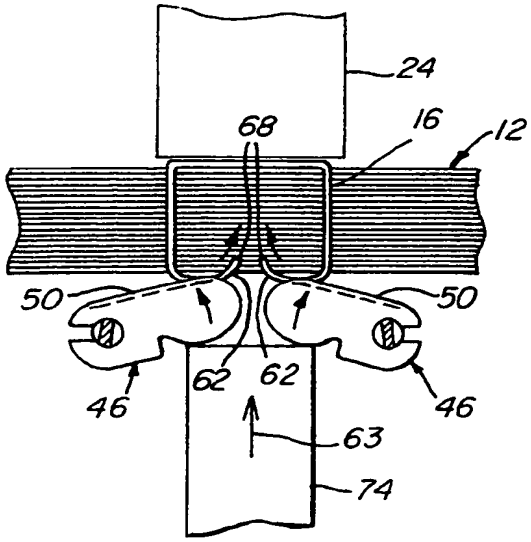

Fig. 5C

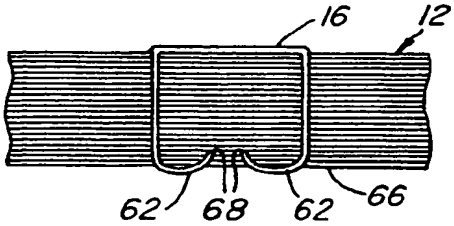

Fig. 5D

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 42 0447

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X Y	WO-A-90 08015 (SWINGLINE INC.) * page 1-3; figures 1,3,5,6 *	1,2,10 3,4,7-9, 11,12	B27F7/19
Y	US-A-4 593 847 (HAGEMANN)	3,4,7-9, 11,12	
A	* column 3, line 50 - column 4, line 33 * * column 5, line 44-54 * * column 6, line 18 - column 7, line 7; figures 1-3,5,7-9 *	6	
A	XEROX DISCLOSURE JOURNAL vol. 8, no. 3 , May 1983 pages 187 - 188 SPEHRLEY, JR.	1,2,4,10	
A	GB-A-2 024 083 (XEROX CORPORATION) * page 1, line 39-42; figures 2,3 *	7-9,11, 12	
A	DE-A-40 20 355 (KODAK AG) * column 4, line 61 - column 5, line 10 * * column 6, line 30-34; figure 4 *	3	TECHNICAL FIELDS SEARCHED (Int.Cl.5) B27F B25C
A	GB-A-2 019 764 (XEROX CORPORATION) * page 3, line 92-113; figure 2 *	5	
A	EP-A-0 322 906 (MAX CO., LTD)		
A	US-A-4 792 077 (FALTIN)		
A	EP-A-0 009 964 (XEROX CORPORATION)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 February 1994	Petersson, B

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)